SECURITY CLASSIFICATION OF THIS PAGE

AD-A207 216

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188
1b. RESTRICTIVE MARKINGS	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	3. DISTRIBUTION / AVAILABILITY OF REPORT: Approved for public release; distribution unlimited.
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S): AFOSR-TR- 89-0504
6a. NAME OF PERFORMING ORGANIZATION: La Jolla Institute, P.O. BOX 1434 — 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION: AFOSR
6c. ADDRESS (City, State, and ZIP Code): La Jolla, CA 92038	7b. ADDRESS (City, State, and ZIP Code): BLDG 410, BAFB DC 20332-6448
8a. NAME OF FUNDING / SPONSORING ORGANIZATION: AFOSR — 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: AFOSR-80-0244
8c. ADDRESS (City, State, and ZIP Code): BLDG 410, BAFB DC 20332-6448	10. SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO. 61102F; PROJECT NO. 2301; TASK NO A4; WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

Low-Energy Atomic Collisions

12. PERSONAL AUTHOR(S)

R.H. Neynaber/ S.Y. Tang

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 6/1/80 TO 9/30/80	31 October 1980	3

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A description of charge-transfer studies of HCl+ in Xe using a mergingbeams technique is given. The work was performed under the Grant No. AFOSR-80-0244. Absolute and relative cross sections were obtained for collision energies from 0.01 to 870eV.

DTIC ELECTE APR 26 1989 S H D

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
Col Jerry J. Perrizo	767-4904	NP

DD Form 1473, JUN 86 — Previous editions are obsolete. — SECURITY CLASSIFICATION OF THIS PAGE

89 4 25 024

LJI-R-80-094

AFOSR-TR- 80-0504

LOW-ENERGY ATOMIC COLLISIONS

FINAL SCIENTIFIC REPORT FOR PERIOD

1 June 1980 - 30 September 1980

Grant No. AFOSR-80-0244

Sponsored By

Air Force Office of Scientific Research

Principal Investigator: Dr. R. H. Neynaber
(714) 454-3581, Ext. 62

AFOSR Project Monitor: Dr. Ralph E. Kelley

La Jolla Institute
P. O. Box 1434
La Jolla, California 92038

31 October 1980

The goal of this experimental program was to study selected chemi-ionization and ion-molecule reactions by merging-beams techniques to better understand the dynamics of such collisions and to provide data to assist in the formulation of theory. The relative energy of the reactants for these studies was varied from threshold to 10 or 20 eV.

These studies give a clearer picture of the role played by the kinetic and internal energy of reactants at low relative energies. This is important for the development of advanced Air Force systems that require communication through either a naturally or artificially ionized atmosphere, for the development of propulsion systems for the Air Force, and for advancing the technology of lasers.

ACCOMPLISHMENTS

During the four-month period of the present grant, absolute and relative cross sections Q were obtained for the charge-transfer reaction $HCl^+ + Xe \rightarrow HCl + Xe^+$. The reactants and products are in their ground electronic states, but HCl^+ and HCl may be vibrationally and rotationally excited. The studies were made by a merging-beams technique for a relative kinetic energy W of the reactants from nominally 0.01 to 870 eV. Relative Q and lab-energy distributions of Xe^+ indicate that (a) near-resonant charge transfer preceded by a capture, or orbiting, collision occurs for $0.01 \leq W \lesssim 0.6$ eV, (b) near-resonant charge transfer without capture occurs for $0.6 \lesssim W \lesssim 200$ eV, and (c) non-resonant charge transfer is dominant for $W \gtrsim 400$ eV. The near-resonant charge transfer is apparently fostered by the matching of electronic-vibrational-rotational energy levels of the entrance and exit channels. This results in the conversion of internal energy of HCl^+ into internal energy of HCl.

DTIC COPY INSPECTED 4
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1

A paper has been written and submitted for publication (see below) on the study described above. In addition, the subject will be presented at the 12th Annual Meeting of the Division of Electron and Atomic Physics of the American Physical Society (see below).

PAPERS AND TALKS

Published Papers

R. H. Neynaber and S. Y. Tang, "Charge Transfer of HCl^+ in Xe," submitted to Physical Review for publication.

Talks

R. H. Neynaber and S. Y. Tang, "Charge Transfer of HCl^+ in Xe," to be presented at 12th Annual Meeting of the Division of Electron and Atomic Physics, University of Southern California, 1-3 December 1980.

PERSONNEL

R. H. Neynaber and S. Y. Tang have conducted the research for this contract.

USE OF RESULTS

Ion-molecule reactions such as charge-transfer are useful, for example, in the development of laser technology and in understanding atmospheric, nuclear weapons, and fusion reactor effects.

The charge-transfer studies for HCl^+ in Xe are relevant to the development of XeCl lasers. These lasers operate in the blue-green region of the visible

spectrum and are useful, for example, to certain naval operations. Researchers such as L. Champagne and L. Palumbo at the Naval Research Laboratory are trying to develop a XeCl laser. The charge-transfer reaction represents a loss mechanism for Xe, which otherwise could be used to generate the desired excimer $XeCl^*$.

It is interesting to note, as described above, that internal energy of HCl^+ is converted into internal energy of HCl by the charge-transfer reaction. The excited HCl can then dissociatively recombine with electrons to form Cl^-, i.e., $HCl^* + e \rightarrow H + Cl^-$. This would explain the observation of Cl^- in the laser medium by developers of the XeCl laser.